Opportunities for Predictions and Prediction Research

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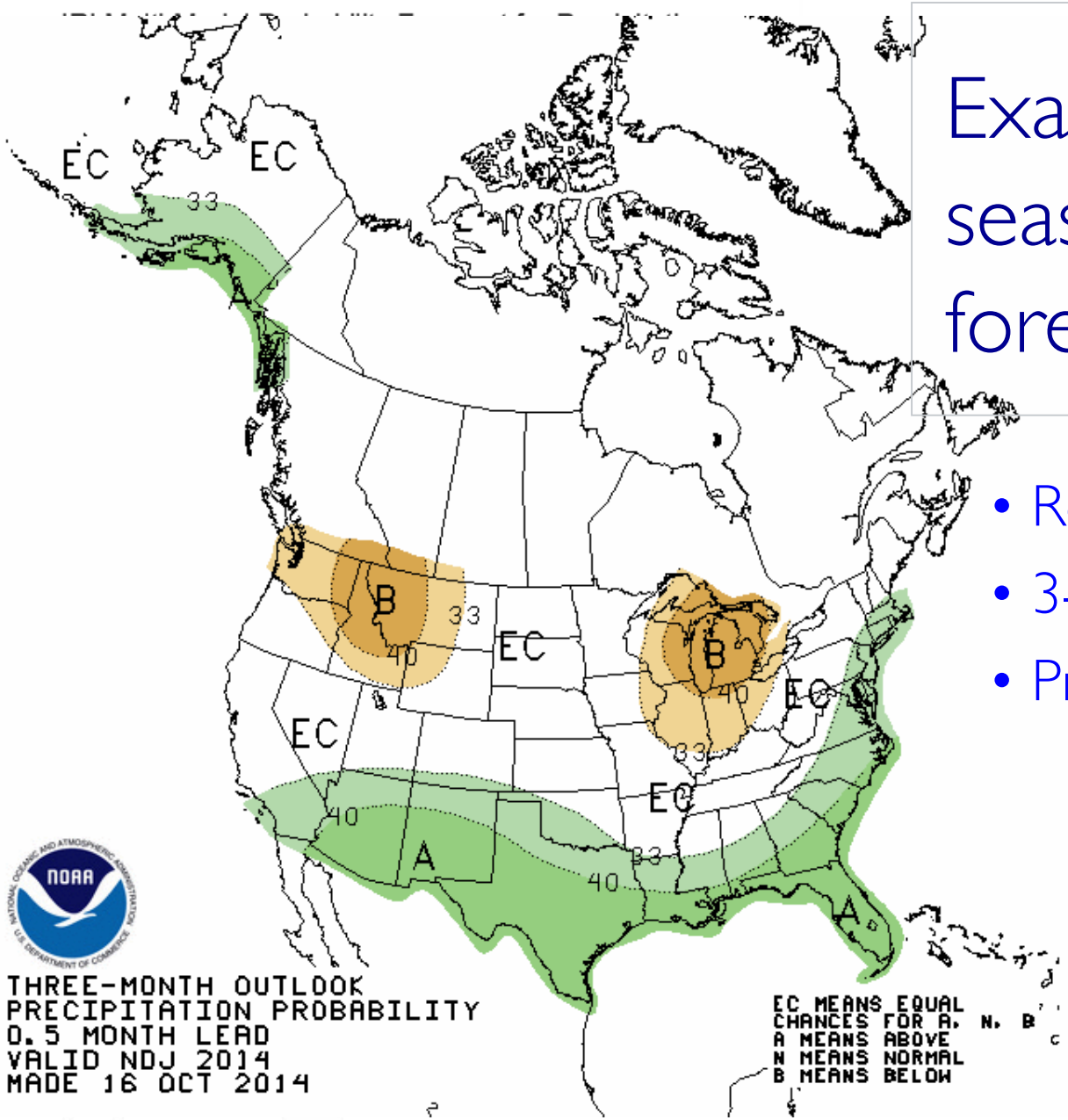
We gratefully acknowledge our support from NOAA for much of this work.

Thanks to Andy Robertson, Tony Barnston, Walter Baethgen and Phil Sansom

Example of seasonal rainfall forecast



- Regional
- 3-month average
- Probabilistic

Opportunities

- Reliability (and sharpness)
- Subseasonal-to-Seasonal information
- Sector-based forecasts

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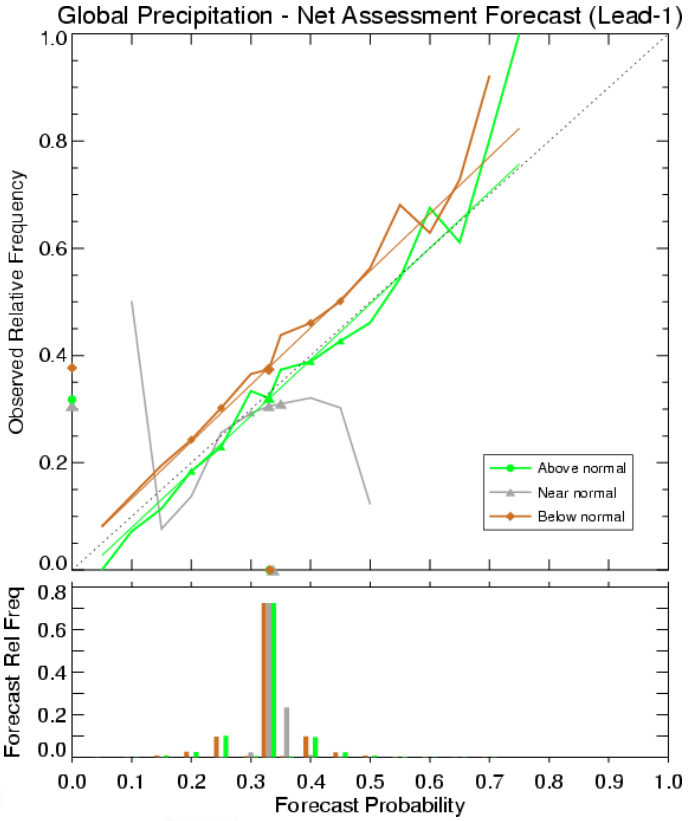
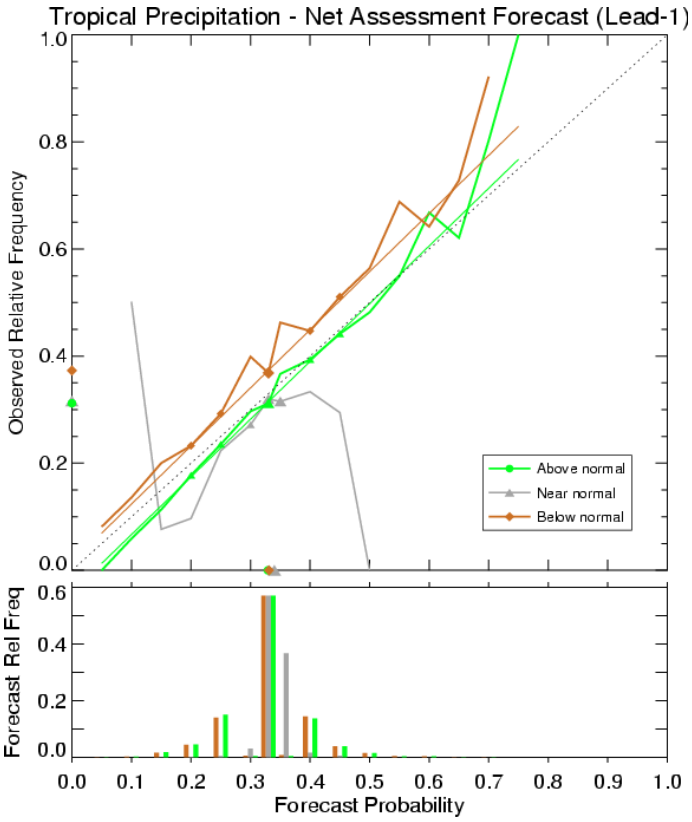
A Major Goal of Probabilistic Forecasts

Reliability!

Forecasts should "mean what they say".





How might we process ensemble forecasts?

One family of statistical post-processing methods is defined by

$$Y \sim N\left(a + b\overline{X}, c^2 + d^2 S^2\right)$$

Y is the observed climate, and $\overline{X}$ & S^2 are the ensemble mean & variance.

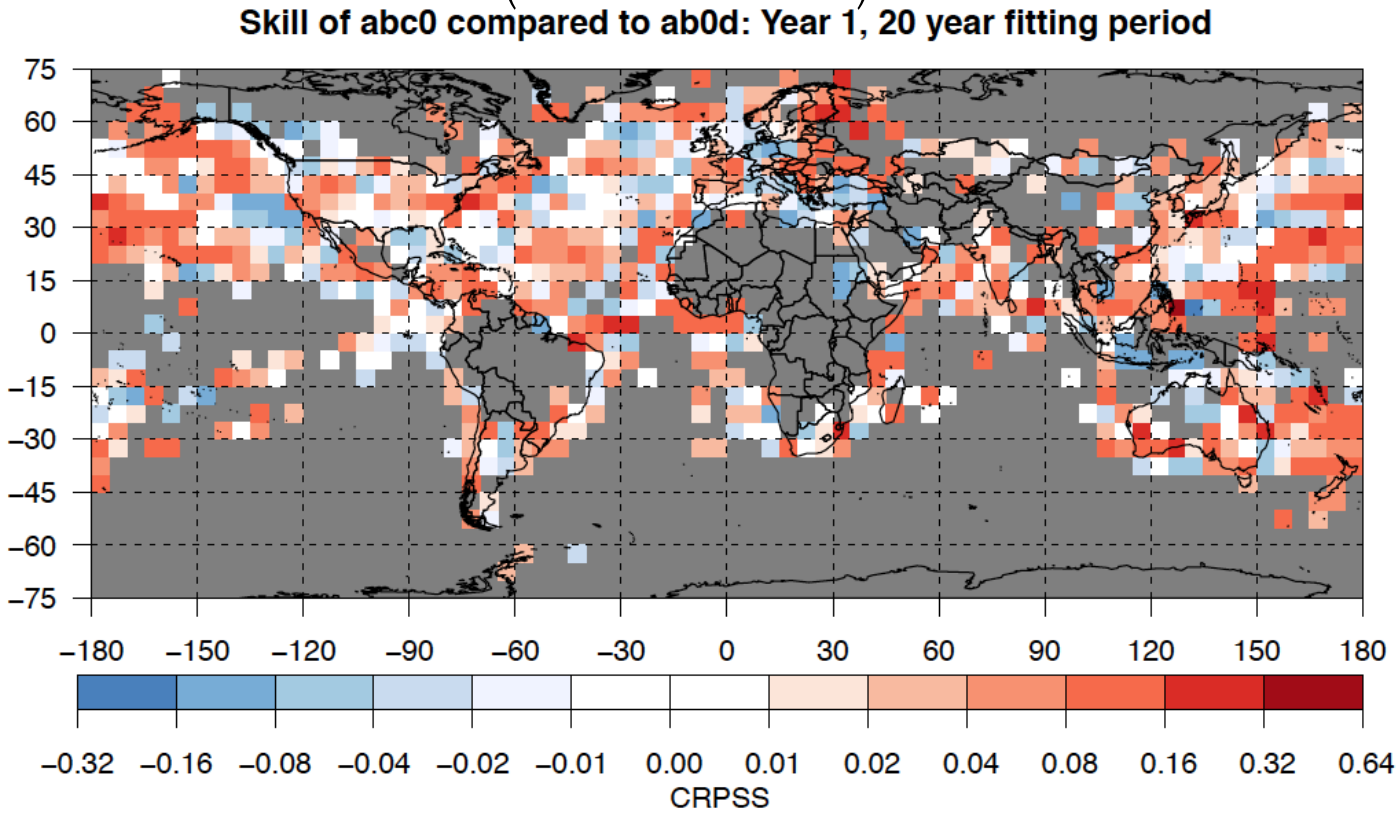
The parameters are easily interpreted as:

- a unconditional bias in the ensemble mean;
- b conditional bias in the ensemble mean;
- c^2 unconditional bias in the ensemble variance;
- d^2 conditional bias in the ensemble variance.

Gneiting et al., 2005, Mon. Wea. Rev.

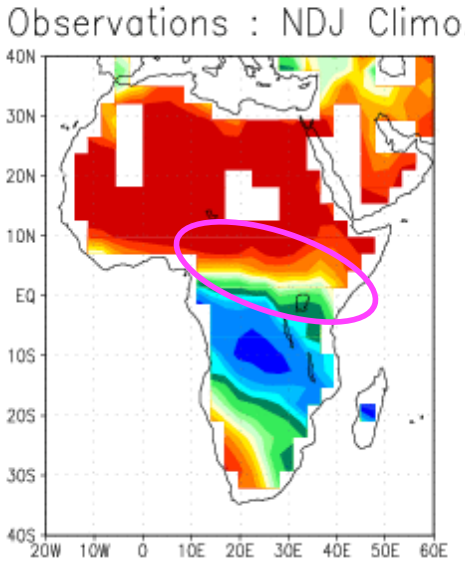
How should we estimate forecast uncertainty?

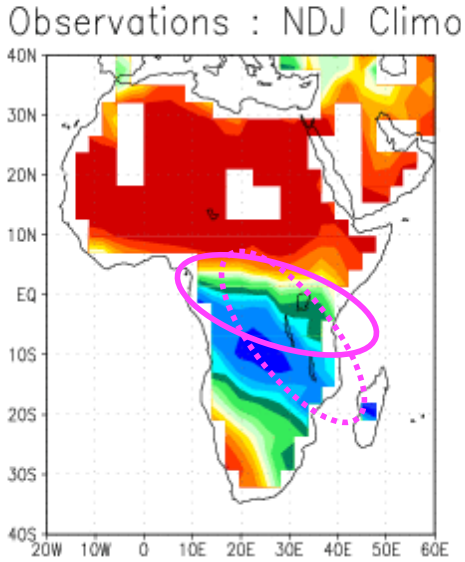
$$Y \sim N\left(a + b\overline{X}, c^2 + d^2 S^2\right)$$



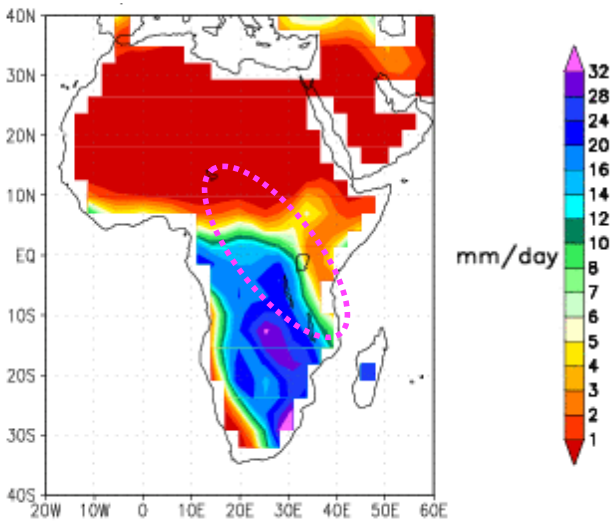
The MSE of the adjusted forecasts tends to outperform the scaled ensemble variance.

Errors & Biases in GCMs





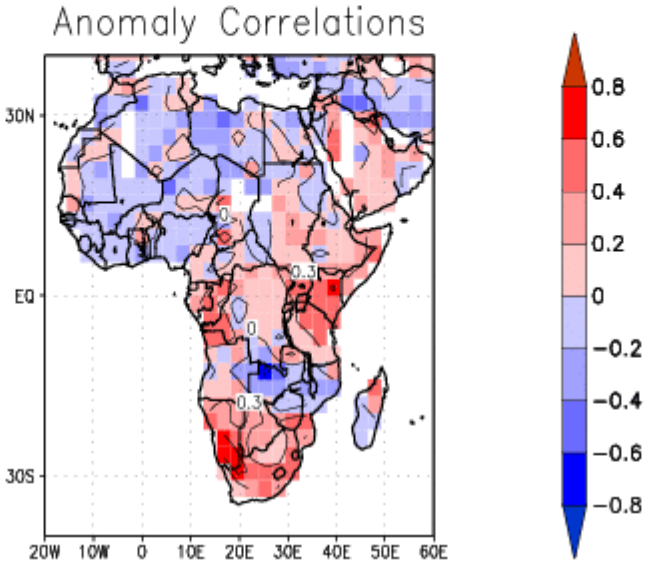
MODEL



Error in mean rainfall pattern

→ error in interannual rainfall variability pattern

→ Lack of skill locally.



Based on Goddard & Graham (1999)

Pattern Correction using Linear Multivariate Linear Methods: CCA, MCA, … based on hindcasts vs obs

Uses coupled patterns of model forecasts vs. obs.

Usually is applied to the ensemble mean model forecast.

Result: When model predicts pattern A, it should be corrected to pattern B. One or more modes of such pattern correction is done. Cross-validation can be used to determine truncation point for mode number.

Pattern correction includes the local corrections for mean bias and amplitude bias, but not spread bias.

Source: Tony Barnston, *Virtual Wrkshp on Bias Correction*

FORECASTING THE FULL PDF

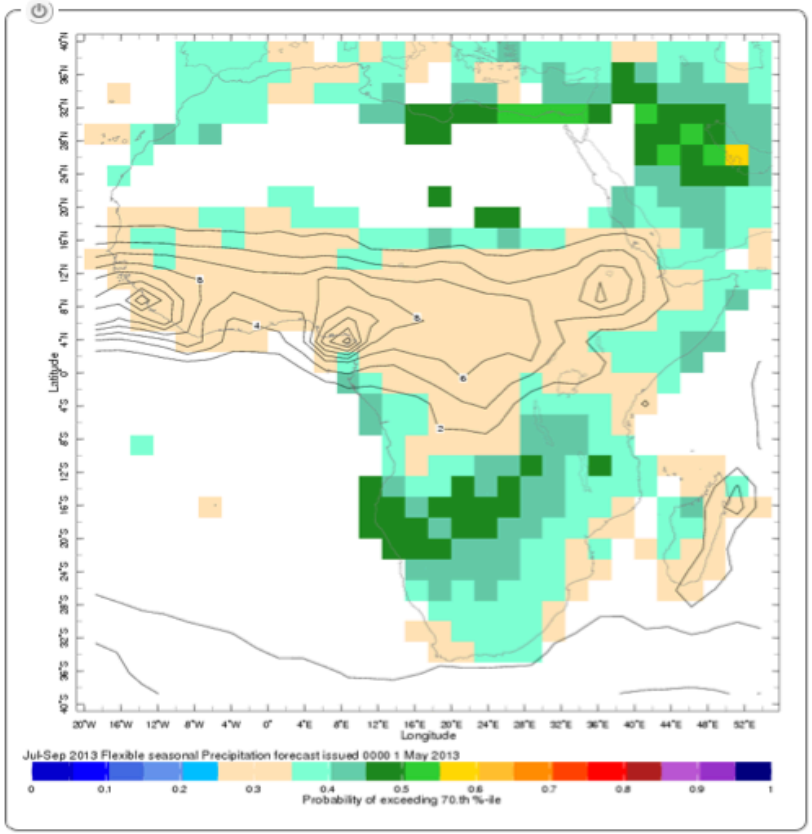
Monitoring: Forecasts | Flexible Forecasts: Precipitation Flexible Seasonal Forecast | Region: Africa
Model: Forecast | Target Time: Jul-Sep 2013 | Climatology (1979 to 2011): 1981 to 2010 | Probability: exceeding | Percentile | 70. %-ile

Description | Dataset Documentation | More Information | Contact Us

Precipitation Flexible Seasonal Forecast

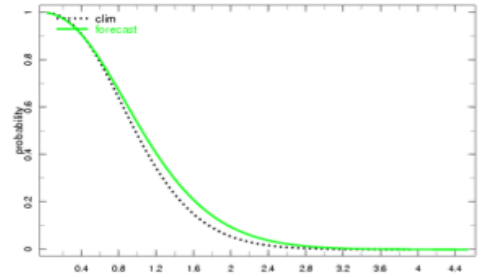
This seasonal forecasting system consists of probabilistic precipitation seasonal forecasts based on the full estimate of the probability distribution.

Probabilistic seasonal forecasts from multi-model ensembles through the use of statistical recalibration, based on the historical performance of those models, provide reliable information to a wide range of climate risk and decision making communities, as well as the forecast community. The flexibility of the full probability distributions allows to deliver interactive maps and point-wise distributions that become relevant to user-determined needs.



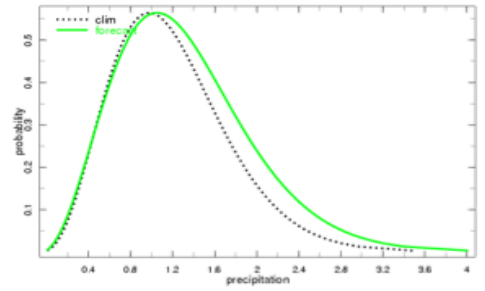
Target Date	Issue Date	Lead Time
Jul-Sep 2013	0000 1 May 2013	3.5

Probability of Exceedance



Jul-Sep 2013 issued 0000 1 May 2013 at (16.25E,3.75S)

Probability Distribution



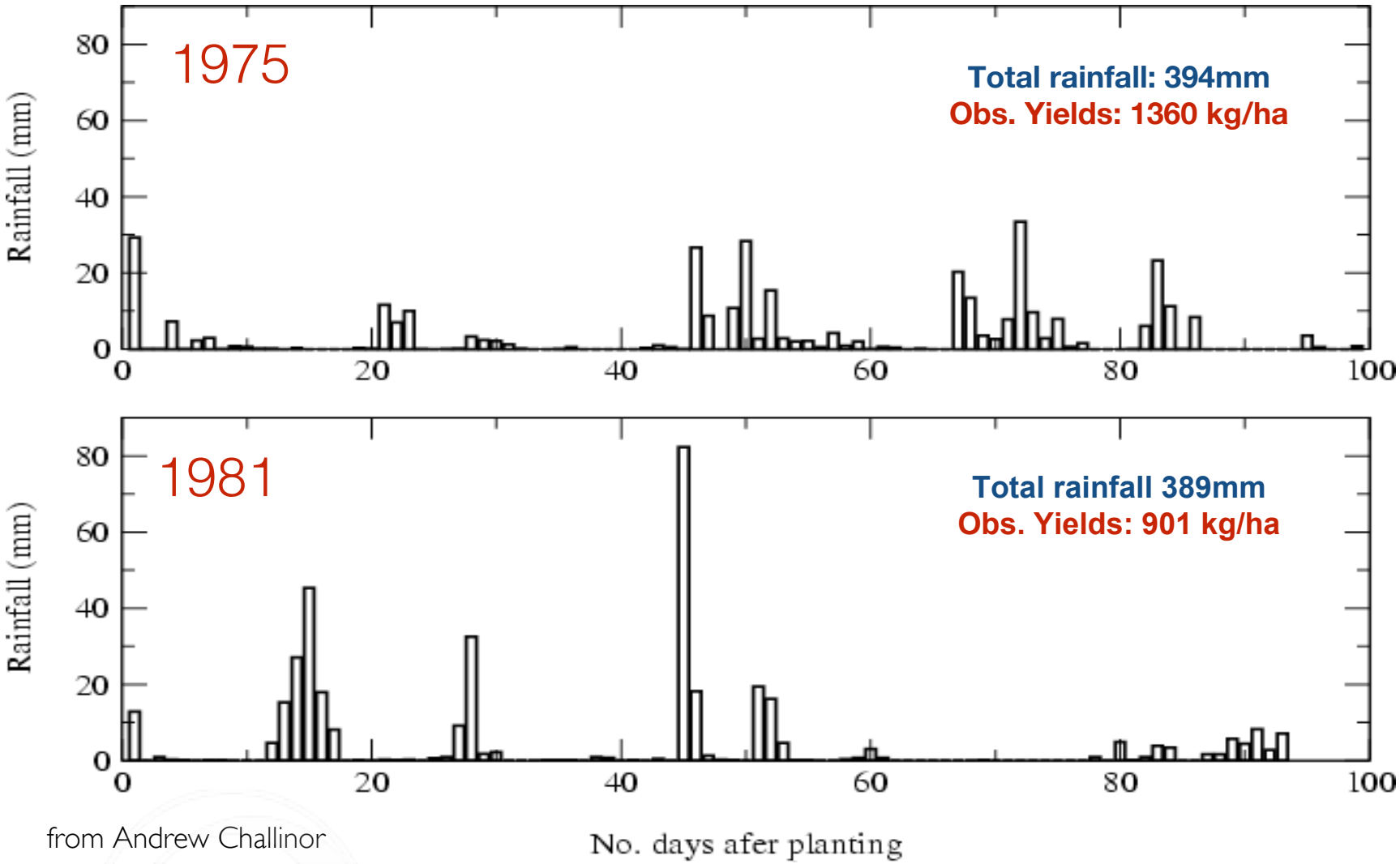
The default map shows globally the seasonal precipitation forecast probability (colors between 0 and 1) of exceeding the 50th percentile of the distribution from historical 1981-2010 climatology. The quantitative value (in mm/day) of that percentile is indicated by the contours. The forecast shown is the latest forecast made (e.g. Sep 2012) for the next season to come (e.g. Oct-Dec 2012). Five different seasons are forecasted and it is also possible to consult forecasts made previously. What makes the forecast flexible is that underlying the default map is the full probability distribution for the forecast and climatology. Therefore, the user can

Opportunities

- Reliability (and sharpness)

- Subseasonal-to-Seasonal information
  - Characterization
  - Prediction
- Sector-based forecasts

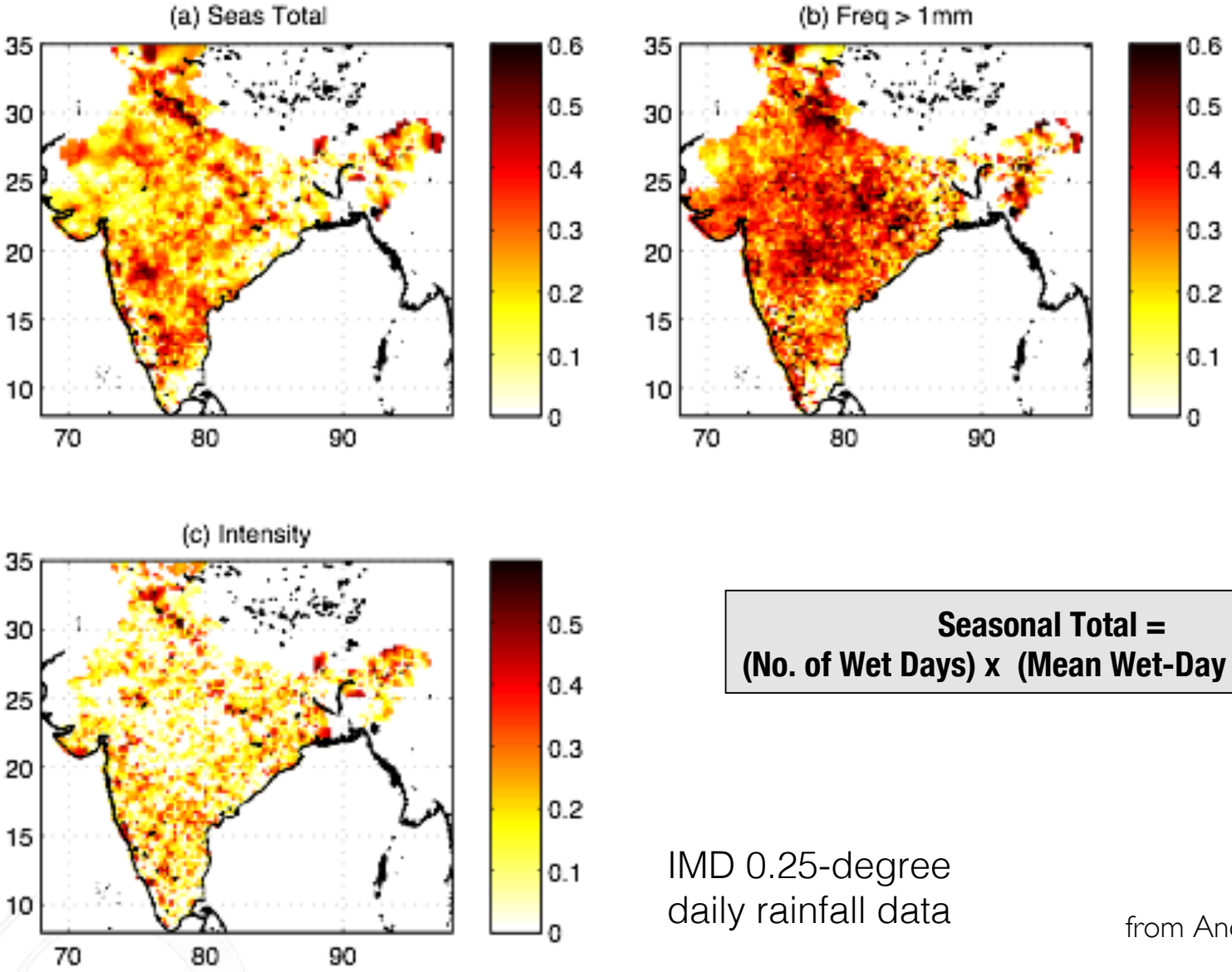
Peanut yields and rainfall in Gujarat, India



from Andrew Challinor

Potential predictability of Monsoon Rainfall from SST

Cross-validated Anomaly Correlation Skill: CCA with contemporaneous SST [40°-290°E, 30°N-30°S],1901–2004



Seasonal Total =
(No. of Wet Days) x (Mean Wet-Day Intensity)

IMD 0.25-degree daily rainfall data

from Andrew Robertson

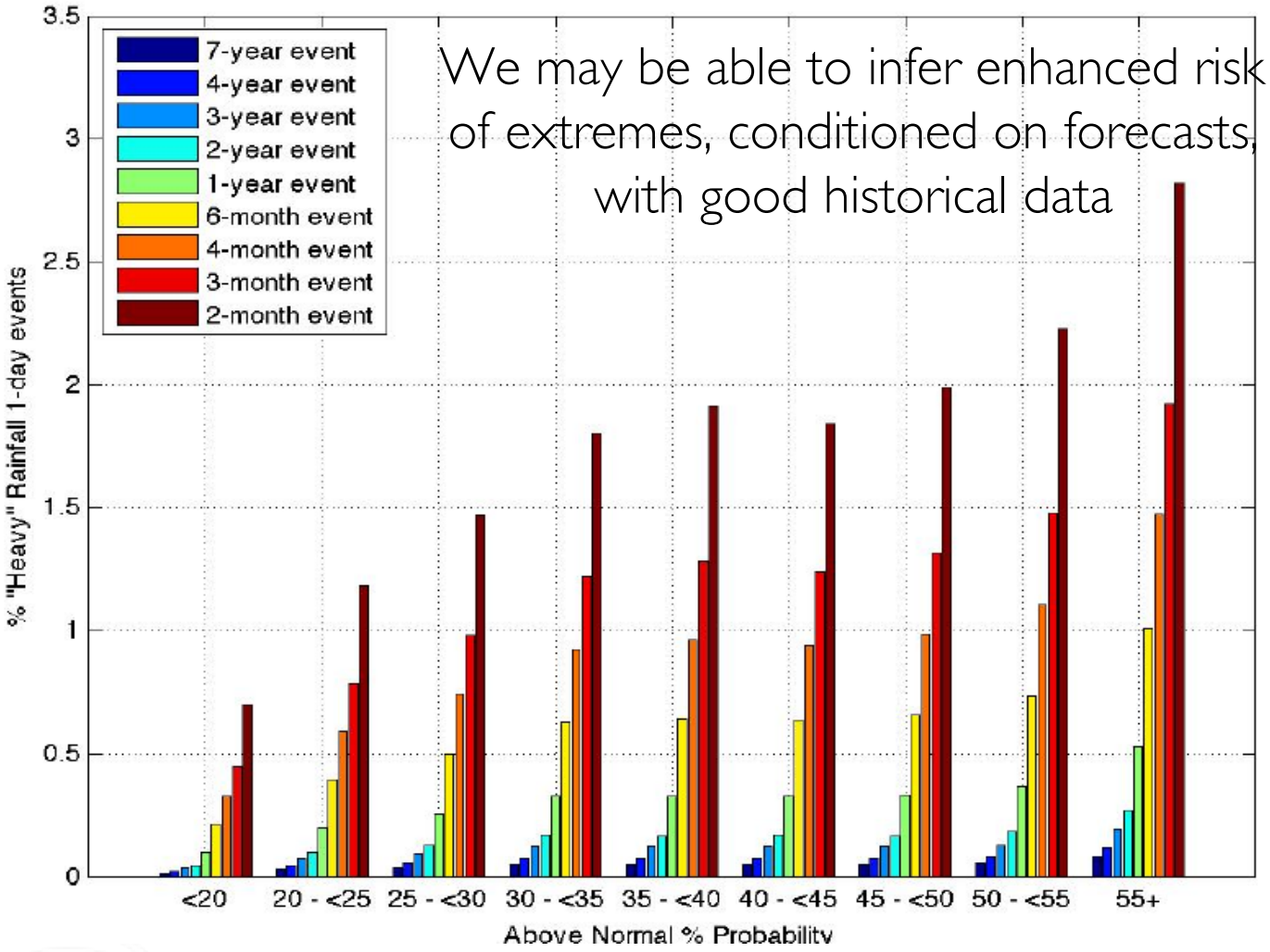
Many decisions in agriculture, water, disaster risk reduction and health fall in the sub-seasonal to seasonal (S2S) range. This time scale has been considered a "predictability desert", and received less work than medium-range and seasonal prediction. The goal of a new WWRP/WCRP joint research project is to improve forecasts and understanding on the S2S scale, and promote uptake by operational centers and use by the applications community.

from Andrew Robertson

- Database of forecasts from 12 Global Producing Centers
- Coordinated research on predictability and modeling
- Strong link to operations and climate services

from Andrew Robertson

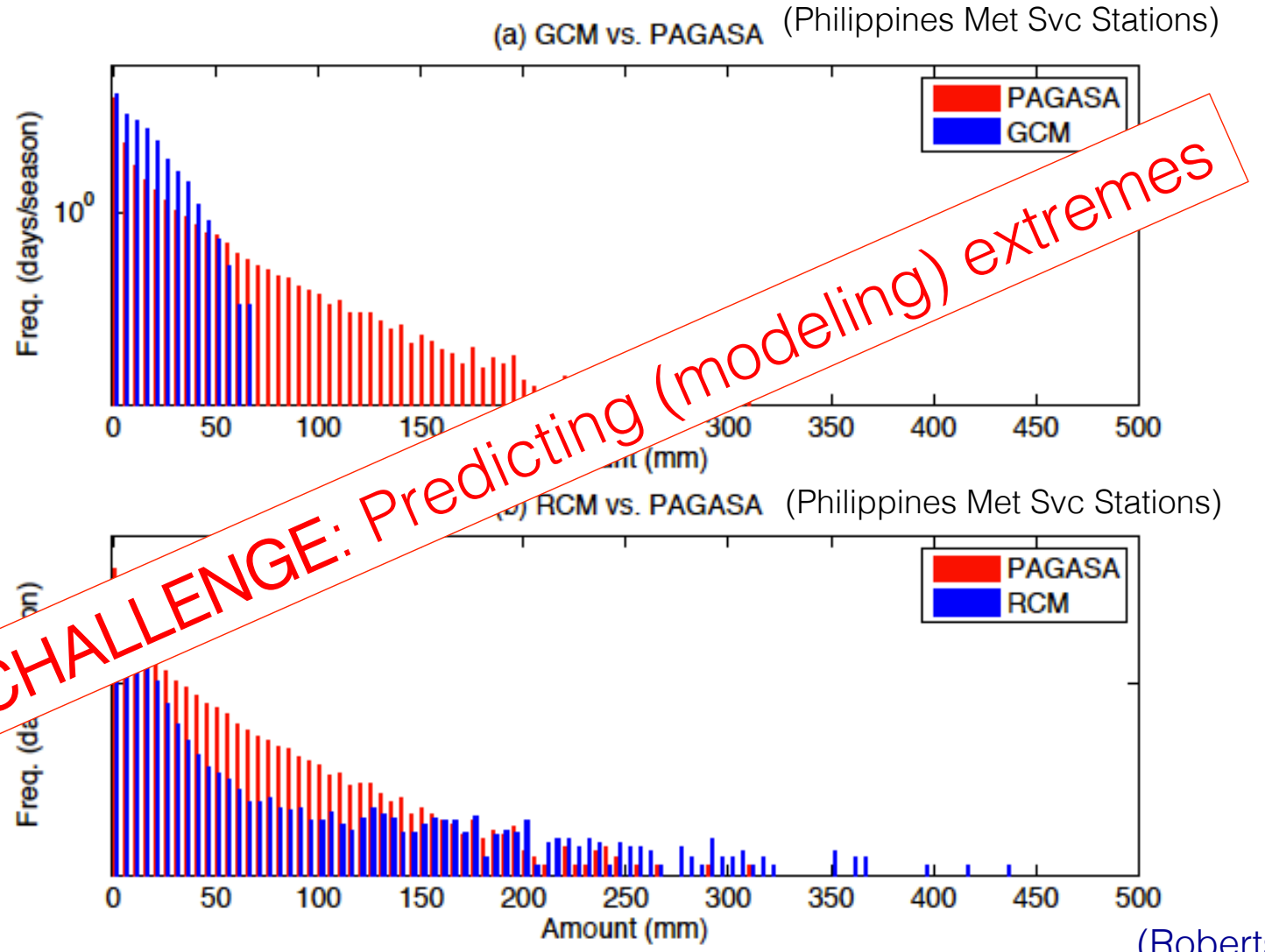
Heavy-rainfall and Seasonal Forecasts



(Courtesy of Simon Mason)

Precipitation Biases

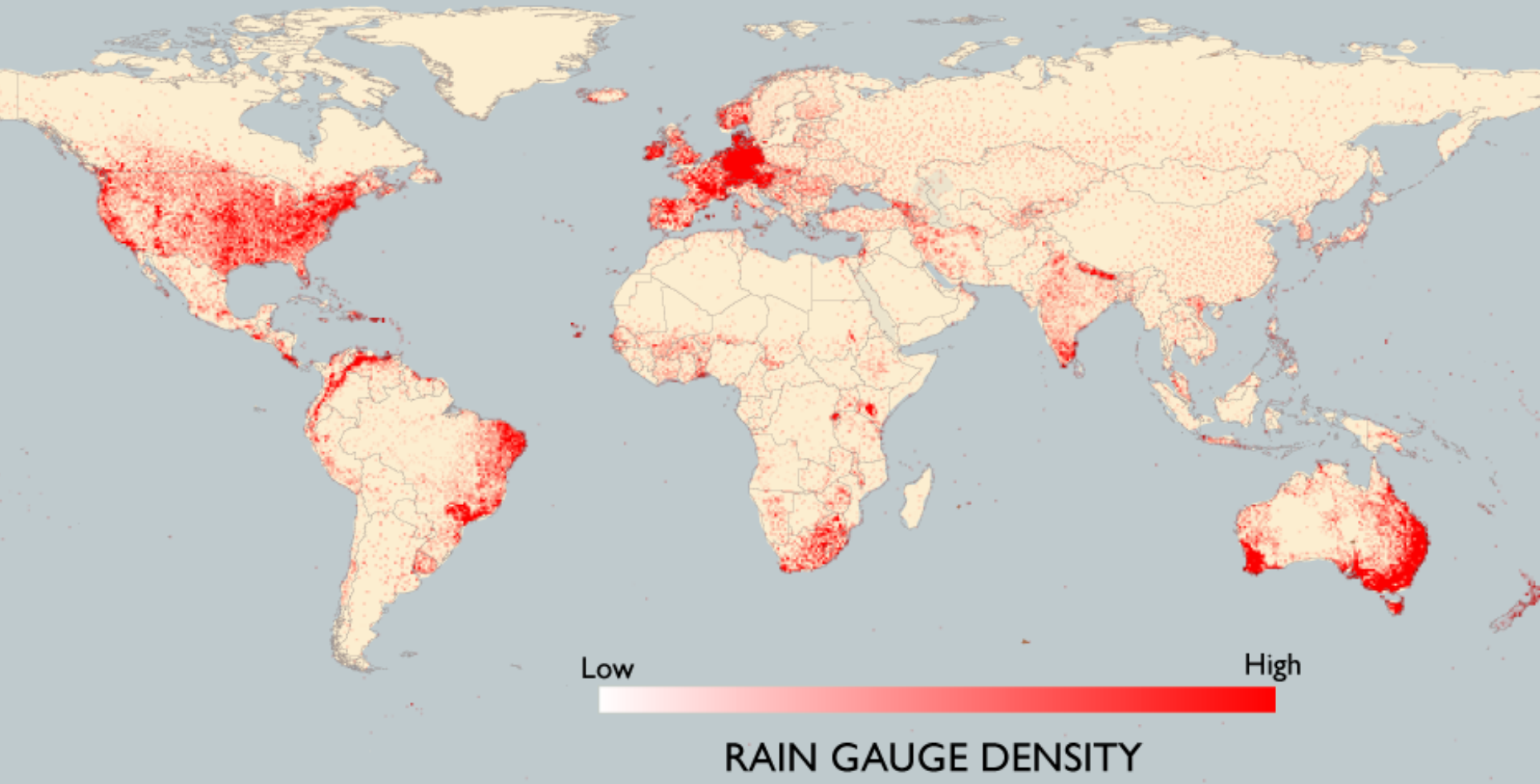
Models don't capture extremes



CHALLENGE: Predicting (modeling) extremes

(Robertson et al. 2012)

ou don’t have observations, how do you know what your target is



Opportunities

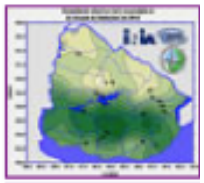
- Reliability (and sharpness)
- Subseasonal-to-Seasonal information
- Sector-based forecasts
  - An example for agriculture in Uruguay

Translating Climate Data into Agronomic Information

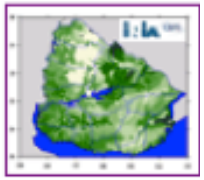
Forecast climate variables, connect with agronomic tools

Example: Forecast Soil Water Balance

Rainfall
Temperatures
Wind
Solar Radiation



Soil Water Storage



from Walter Baethgen

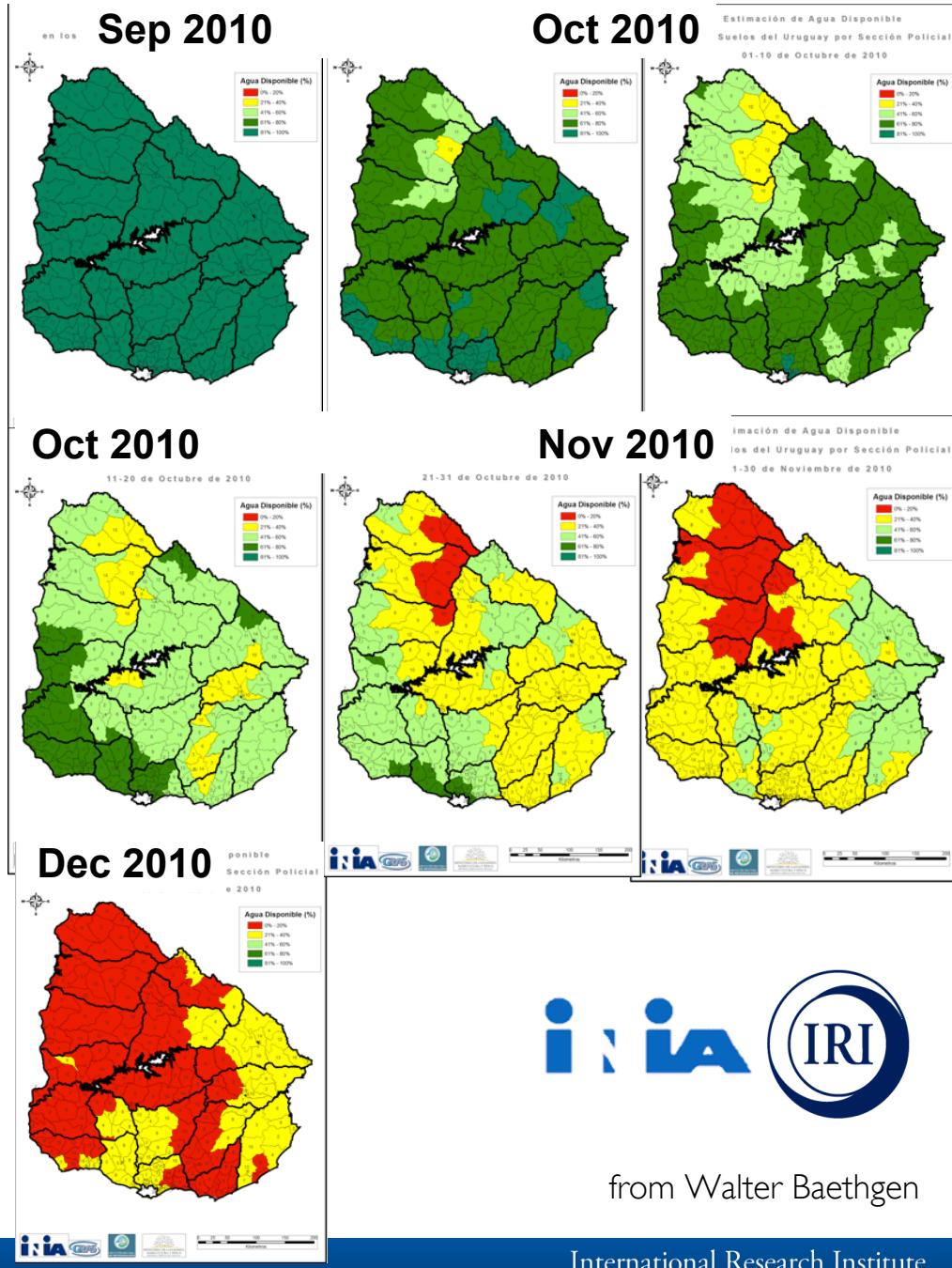
Drought in Uruguay 2010 / 2011:

Monitoring "Translated Climate"
(Soil Water Balance) by County

Information provided
to Ministry of Agriculture and to
National Emergency System
(Evolution of the Drought)

December 2010:

- Official Declaration of Emergency based on this Information
- Established Objective Priority for Aid



from Walter Baethgen

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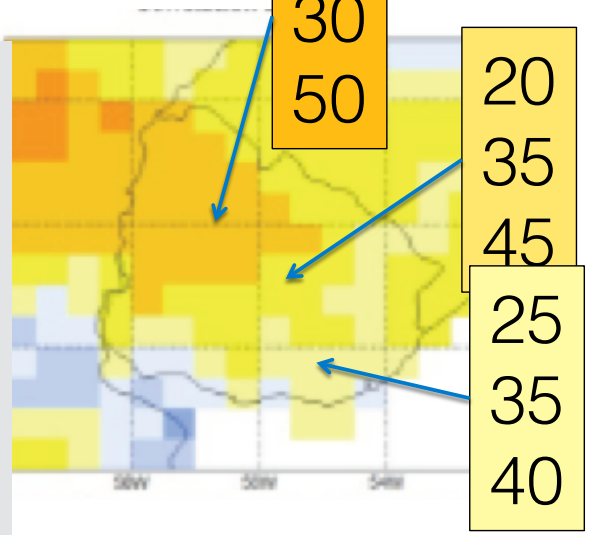
Forecast climate variables, connect with agronomic tools

Example: Forecast Soil Water Balance

Rainfall
Temperatures

FORECASTS
(Terciles)



Resample Climatology (Terciles)

100 realizations

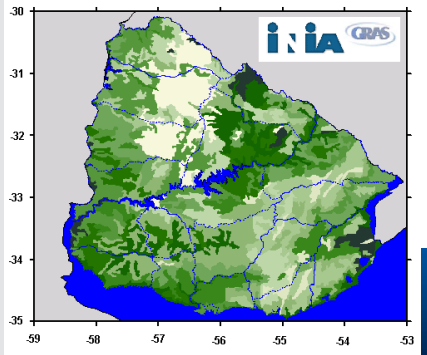
100 realizations

Weather Generator (Forecast)

Soil Water Balance

Probabilistic Forecasts of Available Water to Plants

Soil Water Storage Capacity (mm)



from Walter Baethgen

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Opportunities

- Reliability (and sharpness)
  - Bias correction methodology
  - Improved provision and communication of information and its quality
- Subseasonal-to-Seasonal information
  - Characterization (weather within climate)
  - Prediction
- Sector-based forecasts
  - Tailored climate information merged with environmental/sectoral data
  - Understand the past, monitor the present, predict the future
- *More complete observational datasets*

Thank You!

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